

## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2 <i>atmosphere</i>	More CO <sub>2</sub> in air	More CO <sub>2</sub> released into air
Impact of Increasing Weight 2 on Weight 1	More CO <sub>2</sub> will dissolve into ocean	Strive to equilibrium
Increasing Distance 2	CO <sub>2</sub> in atmosphere increased	Higher temp = higher concentration of CO <sub>2</sub>
Decreasing Distance 2	CO <sub>2</sub> in atmosphere decreased	Lower temp = lower concentration CO <sub>2</sub>

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal
Movement	What causes changes in the system? Movement or change of matter or energy?	Change of matter

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

System strives toward equilibrium. Increased amounts of CO<sub>2</sub> in atmosphere will cause increased amounts of CO<sub>2</sub> to dissolve in ocean.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

Colder water can absorb more  $\text{CO}_2$  which would cause increased acidity. Hotter water temperatures absorb  $\text{CO}_2$  at a slower rate decreasing the rate of acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Because a change in  $\text{CO}_2$  levels is not a factor, ocean acidification would decrease because warmer water can not absorb as much  $\text{CO}_2$ .

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Because system strives towards equilibrium, more  $\text{CO}_2$  will be entering the ocean to reach this balance.

D. Why do you think ocean acidification could be a problem for human society?

Because oceans with a higher acidity are harmful to biological systems which harms the foodchain.

**Class Notes**

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	CO <sub>2</sub> (gas in water)	
Weight 2	CO <sub>2</sub> (gas in atmosphere)	
Fulcrum	Temperature of Ocean Water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	increasing CO <sub>2</sub> in atmosphere	
Impact of increasing Weight 2 on Weight 1	More CO <sub>2</sub> in air dissolves into oceans More CO <sub>2</sub> in oceans	
Fulcrum	Temperature changes the amount of dissolve CO <sub>2</sub>	

**NOTES:**

Warmer = less CO<sub>2</sub> it can hold

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Objectives**

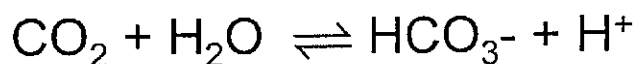
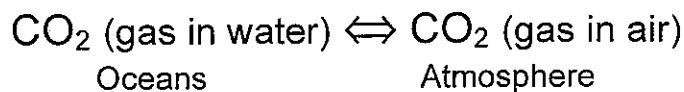
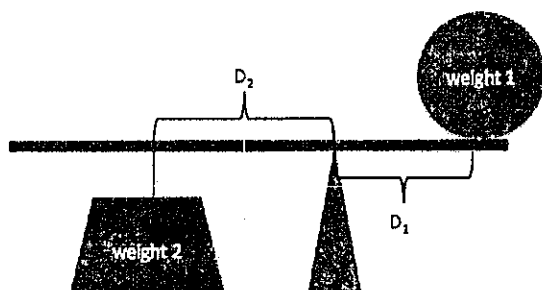
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

**PART 1: Background Notes**



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

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## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	more CO <sub>2</sub> in atmosphere	more weight means more CO <sub>2</sub> in atmosphere
Impact of Increasing Weight 2 on Weight 1	more CO <sub>2</sub> would dissolve into ocean	increasing amount of CO <sub>2</sub> in atmosphere (weight 2), causes increase in CO <sub>2</sub> in ocean (weight 1)
Increasing Distance 2	ocean gets colder	when distance increases just like CO <sub>2</sub> increases in cold water
Decreasing Distance 2	Ocean gets warmer	when distance decreases just like CO <sub>2</sub> decreases in warm water

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	chemical
weights, position of the weights, fulcrum	What causes changes in the system? Movement or change of matter or energy?	temperature, amount of CO <sub>2</sub> in atmosphere

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

More CO<sub>2</sub> in the atmosphere means that more has to dissolve in the ocean for there to be equilibrium. However, an increase of CO<sub>2</sub> in the atmosphere would cause an increase in temperature of the atmosphere which would increase the temperature of the ocean which would mean less CO<sub>2</sub> could be dissolved.

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Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

higher temperature = less  $\text{CO}_2$  is dissolved = lower acidity

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean would get warmer, so less  $\text{CO}_2$  would be dissolved, which means lower acidity

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More  $\text{CO}_2$  in atmosphere means more  $\text{CO}_2$  in oceans which would lead to higher acidification

D. Why do you think ocean acidification could be a problem for human society?

It could hurt the ocean life that we use for food.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Objectives**

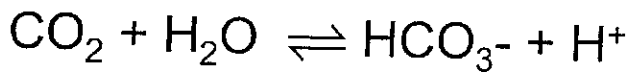
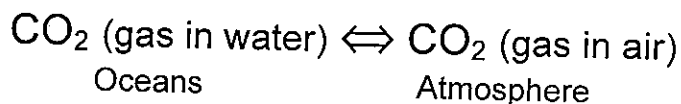
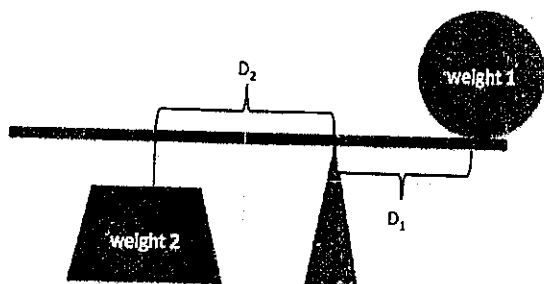
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

**PART 1: Background Notes**



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

GROUP #: 3  
Student IDs of Members Present:  
A42405167  
A42005463  
A432016773

**Class Notes**

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	CO <sub>2</sub> (gas in water)	
Weight 2	CO <sub>2</sub> (in atmosphere)	
Fulcrum	Temperature of ocean water	

→ If temp is low more exchange than expected

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	increase acidification	
Impact of increasing Weight 2 on Weight 1	more CO <sub>2</sub> in the water	
Fulcrum	temp. changes amount of dissolved CO <sub>2</sub>	

more

**NOTES:**




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Chemical Equilibrium & Ocean Acidification

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	Increase in CO <sub>2</sub> in the atmosphere	the systems are always attempting to reach
Impact of Increasing Weight 2 on Weight 1	Increase in CO <sub>2</sub> in the water (oceans)	"equalibrium"
Increasing Distance 2	more CO <sub>2</sub> in the atmosphere	
Decreasing Distance 2	less CO <sub>2</sub> in the atmosphere	

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	Chemical
equilibrium	What causes changes in the system? Movement or change of matter or energy?	equilibrium

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water. When there is an increase in CO<sub>2</sub> in the atmosphere more CO<sub>2</sub> then dissolves in the ocean in order to reach equalibrium. in the system,

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

When the temperature of the water is colder the water can dissolve more gas causing the ocean to be more acidic.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean acidification would be slowed/less due to the warming of the oceans which then would dissolve less  $\text{CO}_2$ .

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

If you increase carbon dioxide in the atmosphere in order to reach equilibrium more  $\text{CO}_2$  would dissolve in the water.

D. Why do you think ocean acidification could be a problem for human society?

It could be a problem because the increase in  $\text{CO}_2$  wouldn't be good for human society

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?

Puts more carbon in the atmosphere  
which would cause the oceans to become  
more acidic

2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

The acidity would decrease algae using  
up the  $\text{CO}_2$



## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	increasing CO <sub>2</sub> in air	Gas in the atmosphere
Impact of Increasing Weight 2 on Weight 1	MORE CO <sub>2</sub> in air MORE CO <sub>2</sub> dissolved in oceans	CO <sub>2</sub> in air must reach equilibrium with CO <sub>2</sub> in oceans
Increasing Distance 2	increasing the amount of CO <sub>2</sub> dissolved in the air	the higher the temp the less CO <sub>2</sub> absorbed
Decreasing Distance 2	decreasing the temp and amount of CO <sub>2</sub> dissolved in the air	the lower the temp the more CO <sub>2</sub> absorbed.

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational energy	Type(s) of energy	Thermal energy
Distance	What causes changes in the system? Movement or change of matter or energy?	temp

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water. The amount of CO<sub>2</sub> in the atmosphere either increases or decreases the amount of CO<sub>2</sub> in the ocean because they must reach a state of equilibrium, because the CO<sub>2</sub> must dissolve into either one

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

The higher the temp of ocean water the slower the process of absorbing  $\text{CO}_2$  & holds less  $\text{CO}_2$  which has less acidity. The lower the temp of ocean water the faster the process of absorbing  $\text{CO}_2$ , and holds more  $\text{CO}_2$  and more acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The warmer the temp, the warmer the water which slows down the absorbing process which means less  $\text{CO}_2$  in the water and less acidity.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increase  $\text{CO}_2$  in atmosphere will lead to an increase of  $\text{CO}_2$  in oceans because they will try to reach a state of equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

When the oceans have more carbon, they can't hold oxygen and so the organisms in the water start dying.

Imbalance of ocean acidification causes problems for the organisms in water and those that depend on them.



## Objectives

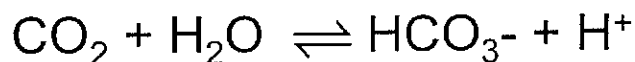
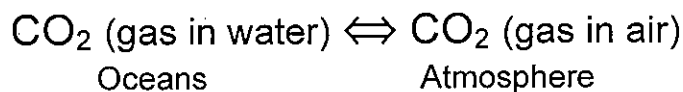
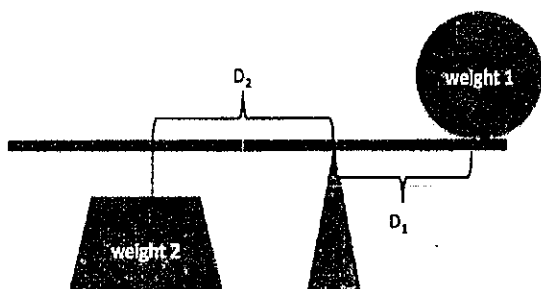
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

## Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

## PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions



**GROUP #:**  
**Student IDs of Members Present:**

**Class Notes**

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1		
Weight 2		
Fulcrum		

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2		
Impact of increasing Weight 2 on Weight 1		
Fulcrum		

**NOTES:**



**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2		
Impact of Increasing Weight 2 on Weight 1		
Increasing Distance 2		
Decreasing Distance 2		

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
	Type(s) of energy	
	What causes changes in the system? Movement or change of matter or energy?	

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

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Chemical Equilibrium & Ocean Acidification

### Questions:

- A. How does temperature of ocean water affect the acidity of the oceans?
- B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?
- C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.
- D. Why do you think ocean acidification could be a problem for human society?

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?





## Objectives

Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

## Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.

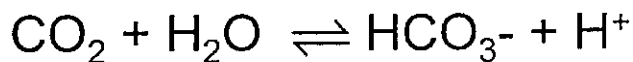
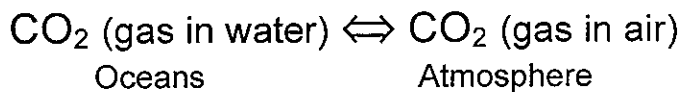
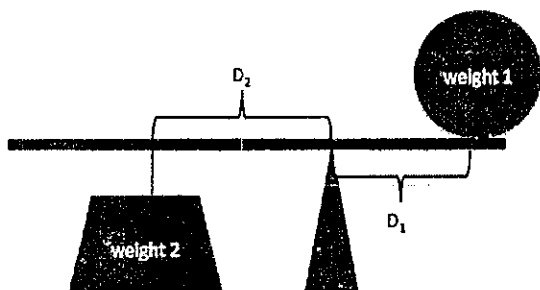
② A system is in **equilibrium** when energy in the system is balanced.

③ Matter moves and changes to return a system to **equilibrium**.

4. **Energy** is needed to break bonds and is released when bonds form.

5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

## PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

GROUP #: 6  
Student IDs of Members Present:  
A43763919 A42600065  
A39966164

### Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	gas in Water	Increase/decrease
Weight 2	gas in atmosphere	changes balance
Fulcrum	temperature of ocean water	Equilibrium

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO <sub>2</sub> in air	Increase
Impact of increasing Weight 2 on Weight 1	more CO <sub>2</sub> in air dissolves into ocean	Increase
Fulcrum	Temp changes amt of dissolved CO <sub>2</sub>	Equilibrium

NOTES:

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Chemical Equilibrium & Ocean Acidification

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	increase in atmosphere	increased
Impact of Increasing Weight 2 on Weight 1	CO <sub>2</sub> from weight 2 dissolves, making weight 1 heavier	increases
Increasing Distance 2	transfer from 2 to 1 in order to achieve equilibrium	changes/transfers to achieve equilibrium
Decreasing Distance 2	transfer from 1 to 2 in order to achieve equilibrium	" "

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal & Gravitational
movement & change of energy	What causes changes in the system? Movement or change of matter or energy?	Movement & change of matter

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

The more CO<sub>2</sub> in the atmosphere there is, the more CO<sub>2</sub> there will be in ocean water because there must be a transfer of CO<sub>2</sub> molecules from the atmosphere to the ocean water in order to achieve equilibrium

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

The hotter the ocean water, the less acidic it will be because the warm, moving  $H_2O$  molecules bounce the  $CO_2$  molecules out.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Sunlight warms the earth, raising ocean temperature, causing  $H_2O$  molecules to move faster, bouncing  $CO_2$  molecules out. Which causes the ocean to be less acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More  $CO_2$  in atmosphere will need to be balanced w/  $CO_2$  levels in ocean water in order to achieve equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

Too much ocean acidification would harm marine life, cause more acid rain (through evaporation) & drinking water would become too acidic to ingest.



**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?



ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Objectives**

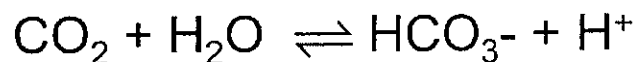
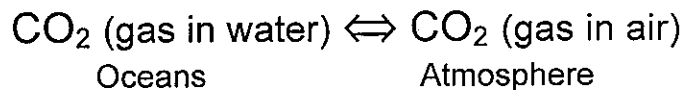
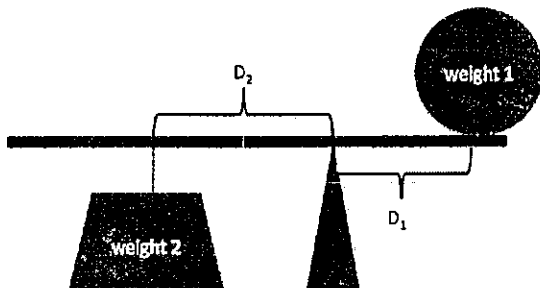
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

**PART 1: Background Notes**



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

### Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	CO <sub>2</sub> Gas in Water	
Weight 2	CO <sub>2</sub> Gas in Atmosphere	
Fulcrum	Temperature of ocean Water	Exchanges between CO <sub>2</sub>

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	More CO <sub>2</sub> in Air <del>Adding CO<sub>2</sub> to atmosphere</del> <del>CO<sub>2</sub> from atmosphere to ocean</del>	
Impact of increasing Weight 2 on Weight 1	More CO <sub>2</sub> in air dissolved, More CO <sub>2</sub> in ocean	
Fulcrum	Temperature changes the dissolved CO <sub>2</sub>	

### NOTES:

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Chemical Equilibrium & Ocean Acidification

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	More CO <sub>2</sub> in the air	Decrease distance of D <sub>2</sub>
Impact of Increasing Weight 2 on Weight 1	Less CO <sub>2</sub> in the water	The weight distribution would be unequal
Increasing Distance 2	Less CO <sub>2</sub> in the atmosphere	Decrease the weight to make equal
Decreasing Distance 2	Increase CO <sub>2</sub> in the atmosphere	Increase the weight to make equal

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal
Equilibrium - <del>Fe</del> Weight	What causes changes in the system? Movement or change of matter or energy?	Equilibrium - <del>Weight</del> Temperature

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

Increases or decreases of CO<sub>2</sub> in the atmosphere will cause increases or decreases of CO<sub>2</sub> in the ocean to maintain equilibrium.

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Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

Colder water can absorb more  $\text{CO}_2$ , so colder waters are more acidic.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The oceans would become warmer and they would be able to hold less  $\text{CO}_2$  (less acidic), so there would be more  $\text{CO}_2$  in the atmosphere.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More carbon in the atmosphere will increase  $\text{CO}_2$  in the ocean which will cause it to be more acidic.

D. Why do you think ocean acidification could be a problem for human society?

Organisms in the water (such as shellfish) would have greater problems protecting themselves from acidic water. Their shells could dissolve.

- it is a problem because it affects marine life and humans economically benefit from.

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?





**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	More gas in ocean	Decreasing of distance 2
Impact of Increasing Weight 2 on Weight 1	More CO <sub>2</sub> in ocean dissolves into more CO <sub>2</sub> in Air	Decrease of distance 2 while increase of distance 1
Increasing Distance 2	Decrease of CO <sub>2</sub> in atmosphere	Decreasing of weight 2
Decreasing Distance 2	Increase of CO <sub>2</sub> in atmosphere	Increasing of weight 2

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Chemical
Gas in water vs Gas in atmosphere	What causes changes in the system? Movement or change of matter or energy?	Increasing/decreasing of weights and distances from fulcrum

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

As CO<sub>2</sub> increases in the atmosphere, the temperature increases which increases the ocean temperature causing the process to slow down.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

Colder water would be more acidic than warmer water.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The process would slow down and making the ocean less acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Because it reaches equilibrium so more  $\text{CO}_2$  would be put into the ocean.

D. Why do you think ocean acidification could be a problem for human society?

Because we use the ocean for food supply and if it becomes too acidic we cannot consume organisms from the ocean.

## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	increase CO <sub>2</sub>	changes balance
Impact of Increasing Weight 2 on Weight 1	more CO <sub>2</sub> in air and in ocean	drives toward equilibrium
Increasing Distance 2	decrease CO <sub>2</sub>	balance + equilibrium
Decreasing Distance 2	increase CO <sub>2</sub>	balance + equilibrium

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	thermal
Movement	What causes changes in the system? Movement or change of matter or energy?	change of matter and/or energy

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

Increasing CO<sub>2</sub> in the atmosphere increases the temperature of the atmosphere. This increases the temperature of the water less CO<sub>2</sub> will be dissolved in the water ~~and the oceans will become less acidic.~~ and the oceans will become less acidic.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

If temperature is high, there will be ~~more~~ <sup>less</sup> exchange of  $\text{CO}_2$ . This would mean that there is ~~less~~ <sup>more</sup> bicarbonate and  $\text{H}^+$  ions in the oceans, which would make ~~less~~ <sup>less</sup> acidic but would also decrease the amount of  $\text{CaCO}_3$  available for organisms to make shells from.

switch answers  
B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The higher the temperature, the less acidic; the lower the temperature the more acidic.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increasing  $\text{CO}_2$  increases temperature of the atmosphere. Increasing the temperature in the air increases the temperature of the ocean, which decreases the likelihood of ocean ~~acid~~ acidification.

D. Why do you think ocean acidification could be a problem for human society? food chain

This would be a problem because it could disrupt the marine food chains in the ocean. If organisms cannot function or build shells, they could die off and prevent other organisms from using them as food.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?



## ISP203A – Global Change Chemical Equilibrium & Ocean Acidification

### Objectives

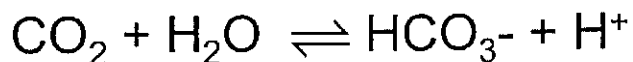
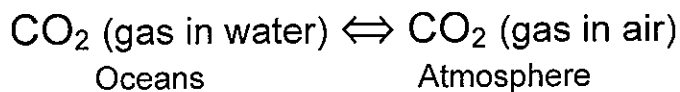
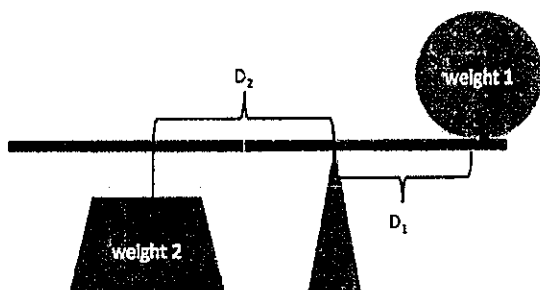
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

### Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

### PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

### Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	CO <sub>2</sub> (Gas in the water)	Increase / Decrease Balance
Weight 2	CO <sub>2</sub> (Gas in the atmosphere)	
Fulcrum	Temperature of the Ocean Water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	More CO <sub>2</sub> in the Air	
Impact of increasing Weight 2 on Weight 1	More CO <sub>2</sub> in air dissolves into the ocean	
Fulcrum	Temperature changes... the amount of CO <sub>2</sub> in Air/Ocean	

### NOTES:



ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	Increase CO <sub>2</sub> in atmosphere	Change balance of CO <sub>2</sub>
Impact of Increasing Weight 2 on Weight 1	Increase of CO <sub>2</sub> dissolved in Ocean to balance out	Change balance of CO <sub>2</sub>
Increasing Distance 2	Decrease of CO <sub>2</sub> in water	Change balance of CO <sub>2</sub>
Decreasing Distance 2	Increase of CO <sub>2</sub> in water	Change balance of CO <sub>2</sub>

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational Energy	Type(s) of energy	Thermal Energy
movement	What causes changes in the system? Movement or change of matter or energy?	change of matter/energy

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

Changes in CO<sub>2</sub> in the atmosphere are constantly changing CO<sub>2</sub> levels in the ocean to reach equilibrium.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

The colder the temperature, the more acidity there will be in the oceans.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The warming atmosphere would increase ocean acidification.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increased carbon dioxide in the atmosphere results in increased carbon dioxide in the ocean because of equilibrium. This makes the ocean acidification levels rise.

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification could affect the entire biosphere and marine life in the oceans. This could affect human society.

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?



## Objectives

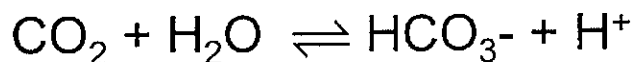
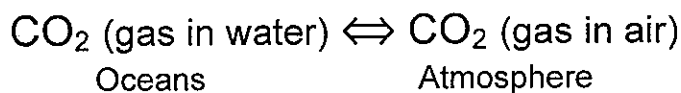
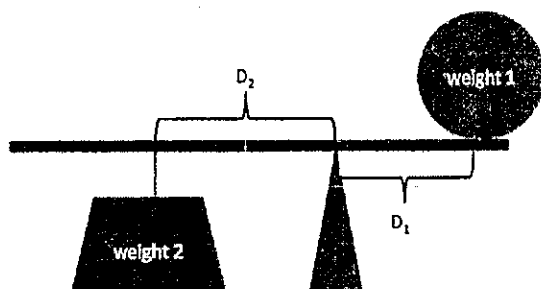
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

## Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

## PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

### Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	CO <sub>2</sub> (gas in water)	increase / decrease in Ocean / atmosphere
Weight 2	CO <sub>2</sub> (gas in atmosphere)	
Fulcrum	temperature of ocean water	system in equilibrium

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO <sub>2</sub> in air	
Impact of increasing Weight 2 on Weight 1	more CO <sub>2</sub> in air dissolves in to ocean more CO <sub>2</sub> in ocean	
Fulcrum	temperature changes the amount dissolved CO <sub>2</sub>	

### NOTES:

## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	increase CO <sub>2</sub> in ocean	increasing weight 2 will need a move in the fulcrum. an increase of CO <sub>2</sub> in the ocean will cause change to get back to equilibrium
Impact of Increasing Weight 2 on Weight 1	increase CO <sub>2</sub> in <del>atmosphere</del> ocean impact on atmosphere	you w. have to move weight one closer to the fulcrum to achieve equilibrium: ocean must balance
Increasing Distance 2	increase CO <sub>2</sub> in atmosphere	increase weight 1, and will have to increase CO <sub>2</sub> in ocean
Decreasing Distance 2	<del>decrease</del> increase CO <sub>2</sub> in ocean	decrease weight 1, have to <del>decrease CO<sub>2</sub> in ocean</del> <del>decrease</del> increase CO <sub>2</sub> in atmosphere

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Kinetic gravitation potential energy	Type(s) of energy	thermal energy
movement	What causes changes in the system? Movement or change of matter or energy?	movement change of matter

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

If there is an increase of CO<sub>2</sub> in the atmosphere, more will be dissolved in the ocean. Because more dissolves in the ocean, the ocean will be more acidic

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

the warmer the water is, the more  $\text{CO}_2$  gets  
"bounced out." So the warmer the water, the  
less acidic it is

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

the air would be warmer, causing the ocean  
to increase in temperature, ~~the~~ resulting  
in a decrease in acidification

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More  $\text{CO}_2$  will dissolve into the ocean

D. Why do you think ocean acidification could be a problem for human society?

When the ocean is too acidic, organisms  
cannot survive, affecting the food chain



**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?



## ISP203A – Global Change Chemical Equilibrium & Ocean Acidification

### Objectives

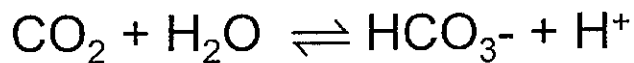
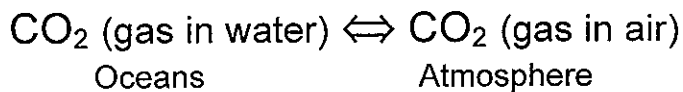
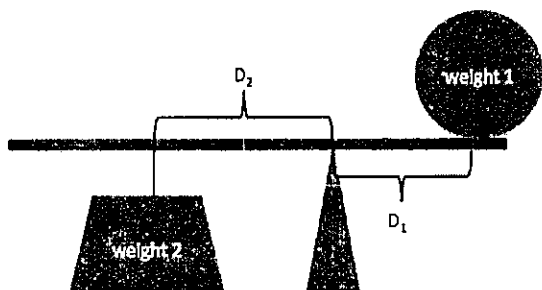
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

### Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

### PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

GROUP #:

Student IDs of Members Present:

A43506836 A40920866

A43272425 A43365634

### Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	CO <sub>2</sub> (gas in water)	
Weight 2	CO <sub>2</sub> (gas in atmosphere)	
Fulcrum	temperature of ocean water	holds it in equilibrium

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	Adding CO <sub>2</sub> to atmosphere	increase changes balance
Impact of increasing Weight 2 on Weight 1	more CO <sub>2</sub> in air, more CO <sub>2</sub> in ocean	
Fulcrum	temperature changes amount of dissolved CO <sub>2</sub>	equilibrium

### NOTES:



ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	Increase of CO <sub>2</sub> in atmosphere	more CO <sub>2</sub>
Impact of Increasing Weight 2 on Weight 1	Increase of CO <sub>2</sub> in oceans	more CO <sub>2</sub> in atmosphere, more in oceans
Increasing Distance 2	decrease CO <sub>2</sub> in atmosphere	<del>equal weights</del> must obtain equilibrium
Decreasing Distance 2	increase CO <sub>2</sub> in atmosphere	

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	thermal, gravitational
Movement	What causes changes in the system? Movement or change of matter or energy?	change of energy (thermal) composition

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

CO<sub>2</sub> in the atmosphere strives to be in equilibrium with CO<sub>2</sub> in oceans, when one level shifts, so does the other

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

Cold water can hold more molecules, acidity will increase

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Warm water cannot hold as much  $\text{CO}_2$  as cold water, less  $\text{CO}_2$  in oceans

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

$\text{CO}_2$  in the atmosphere strives to be in equilibrium with the ocean, increase  $\text{CO}_2 =$  increase acidity

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification could be helped along by human activity that leads to global warming, water can fall out of tolerance range for fish and other animals that live in ocean. Food chain can be affected and ruined

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?

*Increase of run off*

2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

*Increase of algae = decrease  $\text{CO}_2$   
acidity of oceans ↓*





ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Objectives**

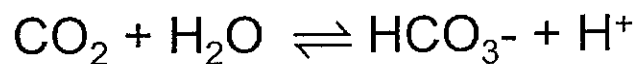
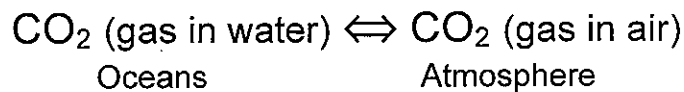
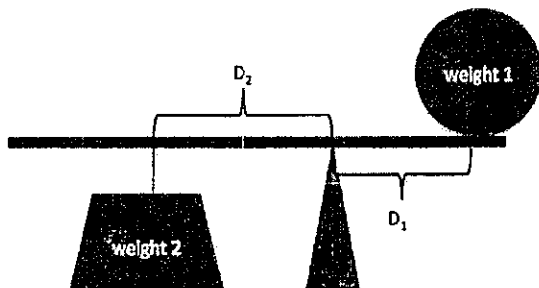
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

**PART 1: Background Notes**



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

### Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	CO <sub>2</sub> in water	
Weight 2	CO <sub>2</sub> in Atmosphere	
Fulcrum	temp of ocean water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO <sub>2</sub> in air	
Impact of increasing Weight 2 on Weight 1	more CO <sub>2</sub> in air dissolves into more CO <sub>2</sub> in ocean	
Fulcrum	temp changes the amount of dissolved CO <sub>2</sub>	

### NOTES:

increasing

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	More CO <sub>2</sub> in air	creates <del>creates</del> equilibrium
Impact of Increasing Weight 2 on Weight 1	More CO <sub>2</sub> in air dissolves into oceans, more CO <sub>2</sub> in ocean	equilibrium
Increasing Distance 2	decrease in CO <sub>2</sub> in water increase in temp	increase in temp
Decreasing Distance 2	Increase CO <sub>2</sub> in water decrease in temp	decrease in temp

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	thermal
Weight & Distance	What causes changes in the system? Movement or change of matter or energy?	temperature

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

It allows for more or less  $\text{CO}_2$  to be dissolved in the oceans.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

It would heat up the ocean, causing less  $\text{CO}_2$  to be dissolved in the ocean.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

The more  $\text{CO}_2$  in the atmosphere results in more  $\text{CO}_2$  being dissolved in the oceans causing acidification.

D. Why do you think ocean acidification could be a problem for human society?

It affects ocean life, and that affects some of our food supply.

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?



## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	increasing CO <sub>2</sub> in atmosphere	INCREASING / DECREASING AMOUNTS OF WEIGHT / CO <sub>2</sub>
Impact of Increasing Weight 2 on Weight 1	increase CO <sub>2</sub> in water to reach equilibrium	
Increasing Distance 2	?	
Decreasing Distance 2	?	

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Mechanical	Type(s) of energy	Thermal, gravitational
Movement of people as well as weight is what is causing changes in the system	What causes changes in the system? Movement or change of matter or energy?	Chemical reactions are occurring to change matter (H <sub>2</sub> O) ions are being produced to make the water more acidic. Thermal energy results in colder water being able to

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in (cold) ocean water.

Changes in CO<sub>2</sub> in the atmosphere causes changes in CO<sub>2</sub> in the ocean water because the system is fighting to reach equilibrium.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

Questions:

A. How does temperature of ocean water affect the acidity of the oceans?

COLDER WATER CAN HOLD MORE CO<sub>2</sub> GAS BECAUSE THE WATER MOLECULES AREN'T MOVING AS FAST. THE CO<sub>2</sub> MOLECULES THEREFORE DON'T BOUNCE OUT.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

THE HOTTER THE ATMOSPHERE, THE HOTTER THE WATER. WITH HOTTER WATER, THE MOLECULES ARE MOVING MORE QUICKLY, SO THE CO<sub>2</sub> MOLECULES BOUNCE OUT. NOT AS MUCH ACIDIFICATION IN HOTTER WATERS.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

WITH AN INCREASE IN CARBON DIOXIDE IN THE ATMOSPHERE, THE CO<sub>2</sub> IN THE OCEAN WILL TRY TO REACH EQUILIBRIUM, THIS INCREASING THE AMOUNT OF OCEAN ACIDIFICATION.

D. Why do you think ocean acidification could be a problem for human society?

MORE OCEAN ACIDIFICATION WILL RESULT IN MORE CO<sub>2</sub> IN THE ATMOSPHERE WHICH CAN LEAD TO A WARMER GLOBAL CLIMATE WHICH CAN CAUSE MULTIPLE SERIOUS PROBLEMS. (GLOBAL WARMING.)



## Objectives

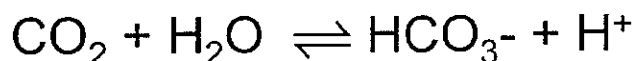
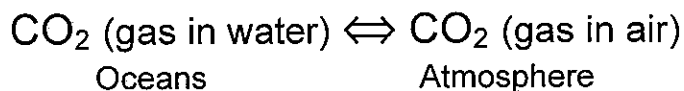
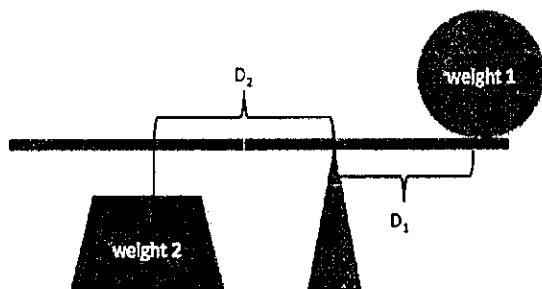
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

## Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

## PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

### Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	CO <sub>2</sub> (gas in water)	
Weight 2	CO <sub>2</sub> (gas in atmosphere)	
Fulcrum	temperature of ocean water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	<del>adding more CO<sub>2</sub> to the</del> more CO <sub>2</sub> in air <del>from atmosphere to ocean</del>	
Impact of increasing Weight 2 on Weight 1	more CO <sub>2</sub> dissolves into ocean more CO <sub>2</sub> in ocean	
Fulcrum	temp changes amount of dissolved CO <sub>2</sub>	

NOTES:

## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	more CO <sub>2</sub> in <del>air</del> ocean	as one increases, the other also increases
Impact of Increasing Weight 2 on Weight 1	CO <sub>2</sub> in ocean evaporates into atmosphere	must balance by evaporating more into atmosphere
Increasing Distance 2	we can decrease weight 2	decreasing weight increase distant
Decreasing Distance 2	we can increase weight 2	decreasing weight increase distant

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	chemical
movement	What causes changes in the system? Movement or change of matter or energy?	change of matter

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

more CO<sub>2</sub> in the atmosphere causes more CO<sub>2</sub> in the ocean water

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

warmer <sup>ocean</sup> ~~ocean~~ → less acidification

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

ocean would warm up → less ocean acidification

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Because when  $\text{CO}_2$  increases in air, the  $\text{CO}_2$  condensates back to the ocean (increases in ocean acidification).

D. Why do you think ocean acidification could be a problem for human society?

Too much acid is harmful to humans

### Part 3: Homework

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?

less CO<sub>2</sub> in atmosphere → less CO<sub>2</sub> in oceans

2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?

less CO<sub>2</sub> in atmosphere → less CO<sub>2</sub> in oceans



## Objectives

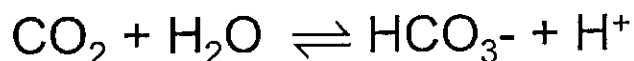
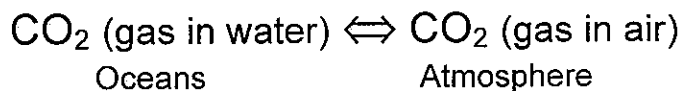
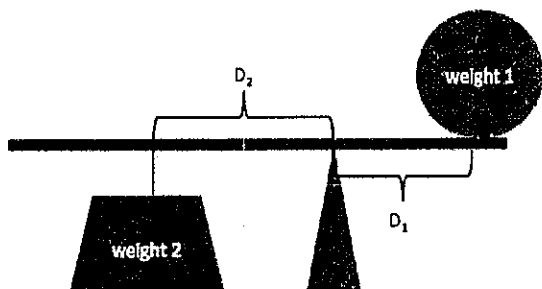
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- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

## Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

## PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

A41944159

**Class Notes**

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1		
Weight 2		
Fulcrum		

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2		
Impact of increasing Weight 2 on Weight 1		
Fulcrum		

**NOTES:**



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## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	increase CO <sub>2</sub> in ocean	increasing
Impact of Increasing Weight 2 on Weight 1	↑ CO <sub>2</sub> in ocean impact on atmosphere	move closer to equilibrium to obtain equilibrium
Increasing Distance 2	↑ CO <sub>2</sub> in atmosphere	incr. weight 1
Decreasing Distance 2	↑ CO <sub>2</sub> in ocean	decr. weight 2.

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Kinetic Gravitational Potential	Type(s) of energy	Thermal
Movement	What causes changes in the system? Movement or change of matter or energy?	change of matter

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

If there is an increase in CO<sub>2</sub> in the atmosphere there will be an increase of CO<sub>2</sub> in the ocean due to equilibrium

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

The warmer the ocean water is the more CO<sub>2</sub> molecules get bounced out.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The air would be warmer and the water would be warmer and less CO<sub>2</sub> would be dissolved in the oceans.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

There would be more dissolved CO<sub>2</sub> in the ocean.

D. Why do you think ocean acidification could be a problem for human society?

Increased acidification in the ocean will cause the deterioration of some organisms, which will cause problems within the food chain and will affect the availability of ocean foods that we commonly eat.

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?



ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Objectives**

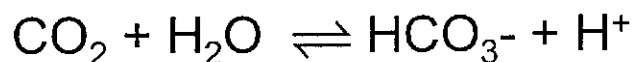
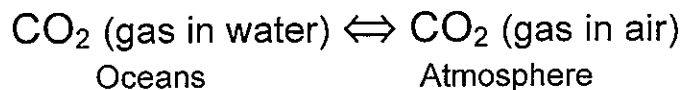
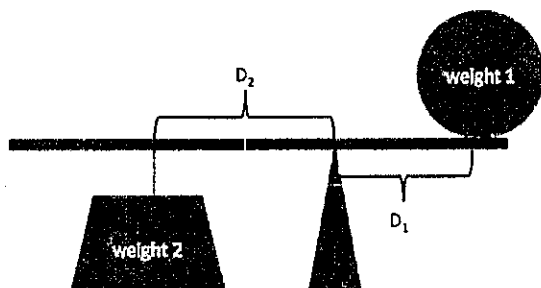
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
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**PART 1: Background Notes**



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

### Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	CO <sub>2</sub> in water	
Weight 2	CO <sub>2</sub> in atmosphere	
Fulcrum	Temp of Ocean Water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO <sub>2</sub> in air	
Impact of increasing Weight 2 on Weight 1	more CO <sub>2</sub> will dissolve in water	
Fulcrum	Temp changes lead to more acid	

### NOTES:

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	More CO <sub>2</sub> in air	Affects CO <sub>2</sub> levels
Impact of Increasing Weight 2 on Weight 1	More CO <sub>2</sub> will dissolve in water	"
Increasing Distance 2	<del>Equilibrium</del> Decrease CO <sub>2</sub> in water	"
Decreasing Distance 2	Increase CO <sub>2</sub> in water	"

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational energy	Type(s) of energy	Chemical energy Thermal energy
Weight, $\Delta$ of matter	What causes changes in the system? Movement or change of matter or energy?	$\Delta$ in energy

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

The balance of equilibrium will alter the CO<sub>2</sub> levels  
in water and atmosphere

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

The colder the water the more acidic

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Higher temperatures mean more acidification

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

The  $\text{CO}_2$  levels are affected by equilibrium. The  $\text{CO}_2$  levels will naturally fix themselves for balance

D. Why do you think ocean acidification could be a problem for human society?

The oceans may become too acidic for fish or humans to be in the water



**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?



**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

Gravitational energy: - Energy started by ~~gravity~~ the pull of gravity

Thermal energy: - Energy created by the change in temp (Something getting hotter)

Chemical energy: - Energy created by the change in chemical composition

Buoyancy: - ~~the~~ materials gravitational pull changes based on density

Lithosphere: - Crust/Top of the asthenosphere

Asthenosphere: - soft bottom of lithosphere

Why Melting Occurs at Subduction Zones: add water to the right temp + pressure

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling: When it cools the density will decrease and it will get colder causes the magma to harden as it reaches the surface

Crust warming: <sup>At the</sup> It because more warming that occurs ~~with density~~ crust. The more ~~dense~~ dense the crust will become. This adds more pressure to the asthenosphere under it so the lava can keep being created.

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

They are both going to become magma at a certain temperature, but due to the density of the basaltic ocean crust, it would be less buoyant. Granite is ~~more~~ less dense than Basalt, so even when its magma it will still be less dense.

████████████████████

████████████████████

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## Part 2. Group Work

In Table C, align the driving energies that correspond with the hot air balloon and the magma. Not all aspects of the hot air balloon will necessarily align with magma. Explain how the hot air balloon and magma are different in Table D.

Table C. Comparing Hot Air Balloon and Magma

Hot Air Balloon	Magma	Driving Energy
Gas flame	Temp changes that cause density changes	Thermal
Differences in air inside and outside the balloon	differences in temp bet magma + rock	Booyancy / Thermal process
Balloon rising	magma rising	GRAVITATIONAL
Balloon floating	magma / rock TEMPS ARE EQUAL	Equilibrium
Outside air heating up during the day	pressure / temp changes DUE TO DEPTH	

Describe specific factors that affect density and buoyancy for the hot air balloon system and the magma system.

Table D. Differences Between Hot Air Balloon and Magma

Hot Air Balloon	Difference	Magma
Temperature + Air pressure Density	Factors impacting density of balloon/magma	Density + Temp
Temp OF AIR	Factors impacting buoyancy	Temp of magma + rock + Density DUE TO DEPTH

**Group Work Questions:**

A. Step back for a moment. In your group's own words, explain the following ideas:

*Gravitational energy:*

*Thermal energy:*

*Chemical energy:*

*Buoyancy:*

*Lithosphere:*

*Asthenosphere:*

*Why Melting Occurs at Subduction Zones:*

**MAKE SURE EVERYONE UNDERSTANDS THESE IDEAS BEFORE MOVING ON!**

B. When magma rises through the crust, the magma cools and the crust gets hotter as heat is transferred from the magma to the crust. Explain what happens to density during this process and how it will affect a magma rising through the crust:

Magma cooling:

Crust warming:

C. Ocean crust is dense and composed mostly of basalt, while continental crust is lower in density and composed mostly of granite. Considering the density differences, would the buoyant force on a basaltic magma be greater in the ocean crust or the continental crust? Explain your reasoning.

# ISP203A – Global Change

## Chemical Equilibrium & Ocean Acidification

### Objectives

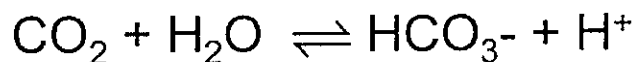
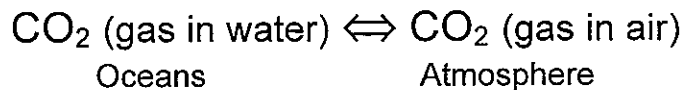
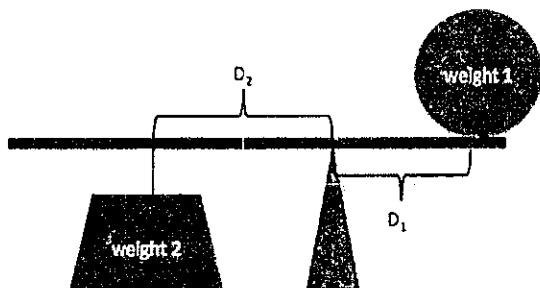
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

### Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
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4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

### PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

**Class Notes**

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	CO <sub>2</sub> (GAS IN WATER)	
Weight 2	CO <sub>2</sub> (GAS IN ATMOSPHERE)	
Fulcrum	TEMPERATURE OF OCEAN WATER.	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	INCREASING PRECIPITATION OF AIR & OCEAN.	
Impact of increasing Weight 2 on Weight 1	MORE CO <sub>2</sub> IN AIR DISSOLVES INTO OCEAN. MORE CO <sub>2</sub> IN OCEANS.	
Fulcrum	TEMP. CHANGES THE AMOUNT OF DISSOLVED CO <sub>2</sub> .	

**NOTES:**



ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	INCREASING CO <sub>2</sub> IN ATMOSPHERE.	BOTH ARE INCREASING, CAUSING IMBALANCE.
Impact of Increasing Weight 2 on Weight 1	MORE CO <sub>2</sub> IN ATMOSPHERE MEANS MORE CO <sub>2</sub> DISSOLVES IN OCEANS.	INCREASING ONE SIDE OF EITHER SYSTEM WILL CAUSE A NEED TO INCREASE THE OTHER.
Increasing Distance 2	LESS CO <sub>2</sub> IN ATMOSPHERE TO BRING SYSTEM BACK INTO EQUILIBRIUM.	LESS IS REQUIRED TO BRING SYSTEM TO EQUILIBRIUM.
Decreasing Distance 2	MORE CO <sub>2</sub> IN ATMOSPHERE TO FURTHER UNBALANCE OCEAN & AIR CO <sub>2</sub> LEVELS.	MORE IS REQUIRED TO BRING SYSTEM TO EQUILIBRIUM.

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
GRAVITATIONAL	Type(s) of energy	CHEMICAL & (MOSTLY) THERMAL.
INCREASING OR DECREASING WEIGHT &/OR DISTANCE ON EQUILIBRIUM.	What causes changes in the system? Movement or change of matter or energy?	CHEMICAL REACTION & MOLECULAR MOVEMENT. INCREASING <sup>↓ for DECREASING</sup> CHEMICAL &/OR THERMAL ENERGY.

CHANGES IN GRAVITATIONAL POTENTIAL ENERGY!

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

It all comes down to equilibrium. If there is more CO<sub>2</sub> in the atmosphere, to reach equilibrium more CO<sub>2</sub> will have to dissolve from the atmosphere into the ocean. If there is less CO<sub>2</sub> in the ~~ocean~~ atmosphere, more CO<sub>2</sub> will degas from the oceans.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

If the water is colder, more  $\text{CO}_2$  will dissolve into it.

If it's warmer, less  $\text{CO}_2$  will dissolve into it.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean acidification would decrease.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

This would occur as a result of the system reaching equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

Higher acidification will kill off corals and many other animals in the ocean. Algae being about the only thing that would live in an environment most of the ocean would be covered in a nasty algae bloom (maybe), and a lot of food sources would die off. Doubtless that would negatively affect ecosystems on land, too.



## Objectives

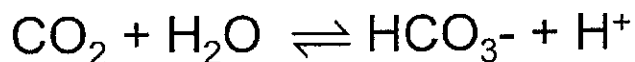
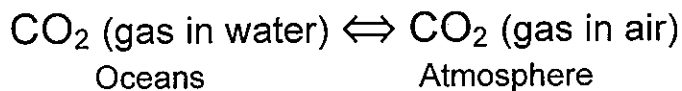
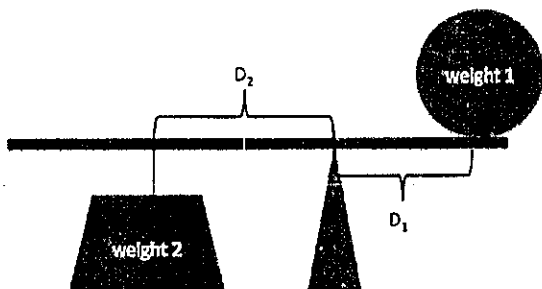
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## Causal Principles

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## PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

**Class Notes**

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1		
Weight 2		
Fulcrum		

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2		
Impact of increasing Weight 2 on Weight 1		
Fulcrum		

**NOTES:**

## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	increasing CO <sub>2</sub> in the atmosphere	increase the balance
Impact of Increasing Weight 2 on Weight 1	increasing CO <sub>2</sub> in atmosphere increasing CO <sub>2</sub> in water to a certain point	increase/decrease the balance
Increasing Distance 2	increase in Temp.	slows up process
Decreasing Distance 2	decrease in Temp.	speeds up process

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational Potential	Type(s) of energy	Thermal
Movement in Matter	What causes changes in the system? Movement or change of matter or energy?	change in Energy

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

If there is an increase of CO<sub>2</sub> in atmosphere, there is an increase in of CO<sub>2</sub> in the water... but only to a certain extend. With more CO<sub>2</sub>, the temp. of water increases, not allowing as much CO<sub>2</sub>.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

higher temp. slows process, decreasing acidity  
and vice versa

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Decrease acidity

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More hydrogen ions

D. Why do you think ocean acidification could be a problem for human society?

There will be more carbon dioxide and humans live off  
of oxygen

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?





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## Objectives

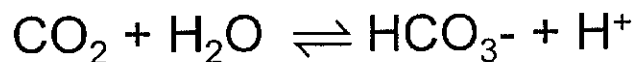
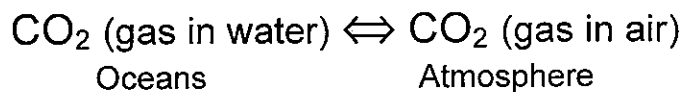
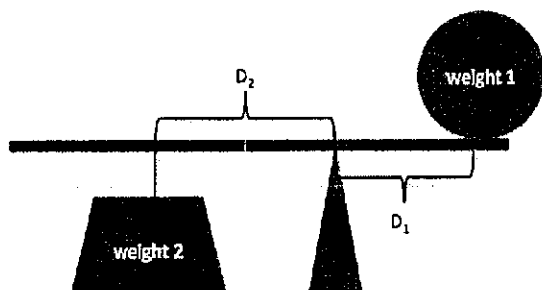
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1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

## PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

### Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1		
Weight 2		
Fulcrum		

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO <sub>2</sub> in atm	
Impact of increasing Weight 2 on Weight 1	more CO <sub>2</sub> in ocean	
Fulcrum	Temp changes amount of CO <sub>2</sub>	

NOTES:

## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	increase CO <sub>2</sub> in Atmosphere	changes balance
Impact of Increasing Weight 2 on Weight 1	increase CO <sub>2</sub> in Ocean	changes equilibrium
Increasing Distance 2	Decreases water temp increase ocean CO <sub>2</sub>	changes temperature
Decreasing Distance 2	Increase water temp decrease ocean CO <sub>2</sub>	Increases temperature

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational energy	Type(s) of energy	Equilibrium
Weight and distance	What causes changes in the system? Movement or change of matter or energy?	Temperature

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

CO<sub>2</sub> in atmosphere is proportionate to CO<sub>2</sub> in oceans depending on Temp.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

*The lower the Temp, the higher the  $\text{CO}_2$ .*

*The higher the  $\text{CO}_2$  the higher the Acidity*

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

D. Why do you think ocean acidification could be a problem for human society?

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?



2d

A42829869

A42839439

A41729348

A37669797

## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	More CO <sub>2</sub> in Air	add CO <sub>2</sub>
Impact of Increasing Weight 2 on Weight 1	More CO <sub>2</sub> in air dissolves into ocean	add CO <sub>2</sub>
Increasing Distance 2	Decrease Weight 2	affects equilibrium
Decreasing Distance 2	Increasing Weight 2	affects equilibrium

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	chemical
Movement and change of matter	What causes changes in the system? Movement or change of matter or energy?	Change of matter and energy

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

If you increase CO<sub>2</sub> in atmosphere you increase CO<sub>2</sub> in the Ocean.

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

If the temperature of ocean is High it absorbs less  $\text{CO}_2$ , therefore the water won't be as acidic.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The ocean acidification would decrease because the Temp would increase from the increase of the Temp of atmosphere.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

If you increase  $\text{CO}_2$  in atmosphere the  $\text{CO}_2$  in ocean would increase because it has to reach equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

We wouldn't be able to go swimming and also it would increase the greenhouse affect. Oh and bad for our drinking water



**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

group 23

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2 atm	increasing CO <sub>2</sub> in atmosphere	more CO <sub>2</sub> in atmosphere & ocean
Impact of Increasing Weight 2 on Weight 1	more CO <sub>2</sub> in water more acid in ocean	more CO <sub>2</sub> in water means more acid in ocean
Increasing Distance 2	decrease CO <sub>2</sub> in atm & stay in equil.	increase temp in atm increases ocean temp.
Decreasing Distance 2	increase CO <sub>2</sub> in atm to stay in equil.	decrease temp. in atm. decreases ocean temp.

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	thermal
movement	What causes changes in the system? Movement or change of matter or energy?	change of matter/energy

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

more CO<sub>2</sub> in the atm means that  
more CO<sub>2</sub> will go into the ocean to  
reach equilibrium.

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

lower temp. means more  $\text{CO}_2$  in the water, which increase Hydrogen ions  $\therefore$  increase in acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

~~the~~ warming the atm would cause the ocean to warm as well. This results in less  $\text{CO}_2$  and less acidity.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

more  $\text{CO}_2$  in the atm results in increase ocean acidification because the ocean reaches equilibrium by allowing more  $\text{CO}_2$ , increasing acidity.

D. Why do you think ocean acidification could be a problem for human society?

If the ocean has too much acidity, it can mess up the ecosystem by killing organisms that live there.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	more CO <sub>2</sub> in air	increase CO <sub>2</sub> in the air
Impact of Increasing Weight 2 on Weight 1	more CO <sub>2</sub> in air dissolves in ocean, therefore more CO <sub>2</sub> in ocean	increase CO <sub>2</sub> in air, ocean absorbs more CO <sub>2</sub> & release CO <sub>2</sub> to achieve equilibrium.
Increasing Distance 2	decrease the weight	increased temp. less CO <sub>2</sub> in air.
Decreasing Distance 2	increase weight	decrease temp more CO <sub>2</sub> in air.

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
gravitational	Type(s) of energy	thermal & chemical
changes in weight & distance causes changes in equilibrium.	What causes changes in the system? Movement or change of matter or energy?	changes in temperature causes changes in the system.

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

If there is more CO<sub>2</sub> in the atmosphere it will be released more into the ocean, to achieve the equilibrium in the both systems. And if there is more CO<sub>2</sub> in ocean it will degas into atmosphere, to achieve equilibrium. The two systems will go back & forth to keep the equilibrium

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

The higher temperature less carbon dioxide enters the water, because of the fast molecule vibration. And vice versa.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

If the atmosphere is warmer that means the ocean is warmer. So the carbon dioxide enters the water slower; the acidification process is slower.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Because ~~can~~ when carbon dioxide in the atmosphere adds up with water it creates carbon acid, causing water acidification in the ocean.

D. Why do you think ocean acidification could be a problem for human society?

Higher level of ocean acidification will harm the ocean organism life; since it will deform the organisms. The food chain, & increased amount of carbon dioxide in limestone, affects the climate.

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

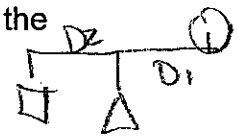


Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	more CO <sub>2</sub> in air	Increases
Impact of Increasing Weight 2 on Weight 1	more CO <sub>2</sub> in air dissolves in ocean	Increases
Increasing Distance 2	CO <sub>2</sub> decreases in ocean so temperature increases	Increases
Decreasing Distance 2	CO <sub>2</sub> increases in ocean so temperature decreases	Increases

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Kinetic Mechanical	Type(s) of energy	Chemical Thermal
weight	What causes changes in the system? Movement or change of matter or energy?	Temperature Density

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

CO<sub>2</sub> in the atmosphere and ocean are at an equilibrium. Therefore, if there is a change in the amount in the atmosphere it will disrupt the equilibrium and the ocean will be thrown out of balance.

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

The temperature of the ocean water affects how much  $\text{CO}_2$  can be transferred between water and air. This will

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

If the Earth's atmosphere temperature increased the ocean acidification would increase because the transfer of  $\text{CO}_2$  between air and ocean would decrease leaving more  $\text{CO}_2$  to degas in the ocean.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

The increase in  $\text{CO}_2$  in atmosphere will increase ocean acidification the  $\text{CO}_2$  degasses in the ocean to try and reach an equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

Ocean acidification could cause a decrease of food in the oceans and could effect the quality of getting water from the oceans. Also it could lead to an increase in  $\text{CO}_2$  in the atmosphere which will increase Earth's temperature and change everything.

## Objectives

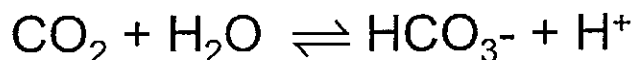
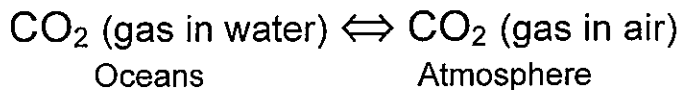
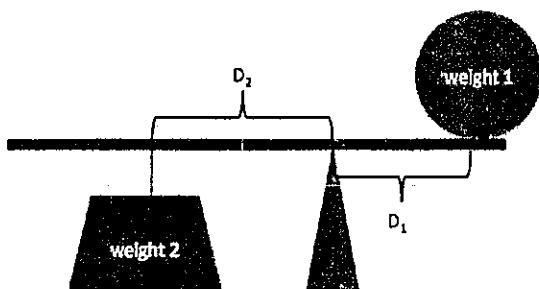
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

## Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

## PART 1: Background Notes



Carbon dioxide reacts with ocean water to produce biocarbonate and hydrogen ions

GROUP #: **26**  
Student IDs of Members Present:  
A39872700  
A42003289  
A40850791 A42707740

**Class Notes**

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1		
Weight 2		
Fulcrum		

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2		
Impact of increasing Weight 2 on Weight 1		
Fulcrum		

**NOTES:**



## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	Increase of CO <sub>2</sub>	Increase
Impact of Increasing Weight 2 on Weight 1	Increases CO <sub>2</sub> in oceans	Increase
Increasing Distance 2	changes CO <sub>2</sub>	Changes
Decreasing Distance 2	↓	↓

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	thermal & chemical
Movement & matter change	What causes changes in the system? Movement or change of matter or energy?	Movement

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

Equilibrium is constantly being achieved, therefore if we increase CO<sub>2</sub> in one reservoir (atmosphere) it will slowly transfer to the ocean to reach equilibrium and vice versa.

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

A lower temperature means there is more  $\text{CO}_2$  in the water,  $\text{CO}_2$  ~~prevents~~ rises the pH (acidity) levels ~~from rising~~ <sup>higher</sup>, so in effect colder water has a ~~lower~~ <sup>higher</sup> acidity & vice versa with warm water.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

It would increase the temp of water & ~~the~~ <sup>decrease</sup> acidity.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

would lead to more  $\text{CO}_2$  in ocean which would result in more acid due to chemical process that leads  $\text{CO}_2$  to carbonate molecules.

D. Why do you think ocean acidification could be a problem for human society?

Less diversity in oceans would result in an affect in the food chain. Precipitation would also be more acidic which could affects crops.

# ISP203A – Global Change Chemical Equilibrium & Ocean Acidification

## Objectives

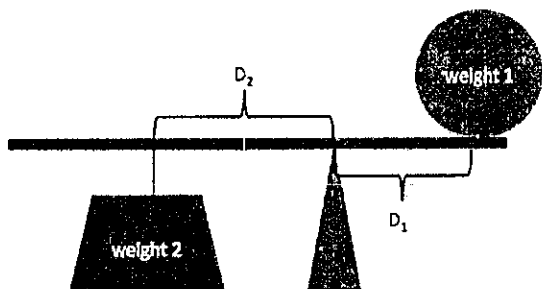
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

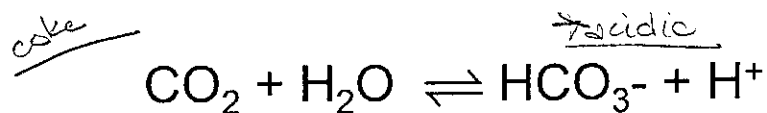
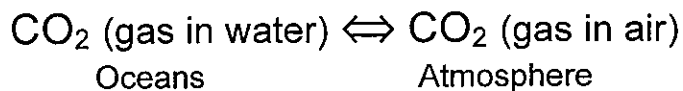
## Causal Principles

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

## PART 1: Background Notes



\* cold water can absorb **MORE** CO<sub>2</sub>. Higher temps Slow process. Lower temps Quickens process.



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

GROUP #:

Student IDs of Members Present:

A40967142  
A42667614  
A40704999  
A42422266

### Class Notes

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	gas in water	
Weight 2	gas in atmosphere	
Fulcrum	temp of ocean water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	more CO <sub>2</sub> in air	increase in oranges
Impact of increasing Weight 2 on Weight 1	more CO <sub>2</sub> in air dissolves into oceans more CO <sub>2</sub> in ocean	
Fulcrum	temp changes the amt of dissolved CO <sub>2</sub>	

NOTES:

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	Increasing CO <sub>2</sub> in atmos.	Both increase (direct analogy)
Impact of Increasing Weight 2 on Weight 1	Increases CO <sub>2</sub> in ocean	Both increase (direct analogy)
Increasing Distance 2	increasing temperature of atmosphere	Both increase (direct analogy)
Decreasing Distance 2	decreasing temperature of atmosphere	Both decrease (direct analogy)

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Chemical
Adding more weight	What causes changes in the system? Movement or change of matter or energy?	Changing temperature (Thermal Energy)

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

The equilibrium will change and so in order to balance out, CO<sub>2</sub> in the water will also change.

If CO<sub>2</sub> in atmosphere increases, so will CO<sub>2</sub> in water.

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

Temperature affects density and therefore can increase or decrease acidity. colder water can absorb more gas

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

If temperatures rise, water will not be able to absorb as much  $\text{CO}_2$  which will decrease acidity

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

A system seeks equilibrium so if there is more  $\text{CO}_2$  in the atmosphere, water will absorb  $\text{CO}_2$

D. Why do you think ocean acidification could be a problem for human society?

Too much acidity changes organisms which will affect human society

**Part 3: Homework**

If you complete the group work, you may work on the homework on your own. This means your answers should be generally unique from other students' answers. **Submit your homework using ANGEL.**

1. You own a forest and decide to cut it down to build upscale condos. How could this affect the acidification of the oceans?
2. Extra nutrients are coming into the ocean due to waste from factory farming. The extra nutrients are causing algal blooms. Algae are known to use up carbon dioxide during growth. How would an increase in factory farming impact the acidity of the oceans?





28

A40678097

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## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	More in air	Both are increasing
Impact of Increasing Weight 2 on Weight 1	More in water, starts to dissolve	Works to "even out"
Increasing Distance 2	Higher temperature - less CO <sub>2</sub> in water	Effects equilibrium
Decreasing Distance 2	Lower temperature - more CO <sub>2</sub> in water	Effects equilibrium

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal / Chemical
Movement	What causes changes in the system? Movement or change of matter or energy?	Change of matter of energy

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

More CO<sub>2</sub> in the atmosphere increases temperature, higher temperature decreases CO<sub>2</sub> in the water

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

Colder water is more acidic because it can hold more  $\text{CO}_2$ .

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

More  $\text{CO}_2$  in air is dissolved, which means less  $\text{CO}_2$  in ocean, because of the high temperature.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

More  $\text{CO}_2$  in the atmosphere means there's more in the water due to equilibrium.

D. Why do you think ocean acidification could be a problem for human society?

Excess  $\text{CO}_2$  is the changing of the chemistry of the sea & providing harmful for many forms of marine life, a more acidic ocean can wipe out species.

## Part 2: Group Work

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	CO <sub>2</sub> added in atmosphere and ocean	Both adding CO <sub>2</sub>
Impact of Increasing Weight 2 on Weight 1	CO <sub>2</sub> increased in ocean	Both adding CO <sub>2</sub>
Increasing Distance 2	CO <sub>2</sub> added in atmosphere, less in oceans	Redistribute how CO <sub>2</sub> is between ocean and atmosphere.
Decreasing Distance 2	CO <sub>2</sub> taken away from atmosphere, more in oceans	Redistribute how CO <sub>2</sub> is between ocean and atmosphere

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal / Chemical
Movement	What causes changes in the system? Movement or change of matter or energy?	Change of matter / energy

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

Decrease in CO<sub>2</sub> in ocean water causes the amount that is degassed into the atmosphere. If CO<sub>2</sub> is increased in atmosphere, CO<sub>2</sub> in oceans increase. Which causes temperature in atmosphere to increase, causing ocean water to increase, lessening amount of CO<sub>2</sub> in oceans because of degassing.

**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

If you increase temperature,  $\text{CO}_2$  increases, which increases acidity.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

Ocean acidification would increase

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

The amount of  $\text{CO}_2$  in air will be in equilibrium of the amount of  $\text{CO}_2$  in ocean, if increased, in air, it will be increased in ocean.

D. Why do you think ocean acidification could be a problem for human society?

The shells in the oceans will be destroyed, which is a main food source for fish, killing them off, and destroying natural habitat in ocean

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ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Objectives**

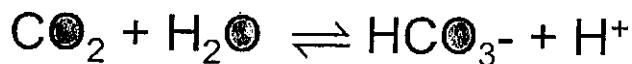
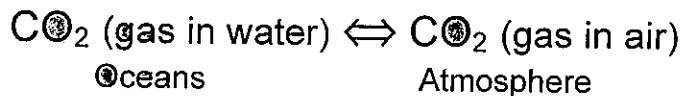
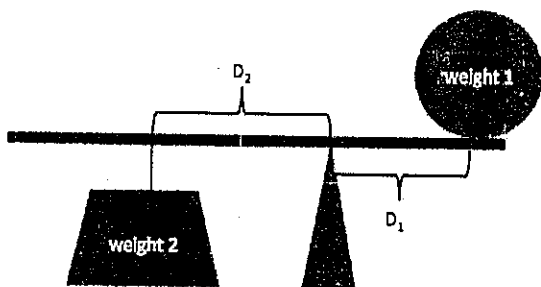
Upon completion of this activity, you will:

- Understand how chemical equilibrium explains how increasing CO<sub>2</sub> in atmosphere and increasing global temperatures can affect the acidity of the oceans.

**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. A system is in **equilibrium** when energy in the system is balanced.
3. Matter moves and changes to return a system to **equilibrium**.
4. **Energy** is needed to break bonds and is released when bonds form.
5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

**PART 1: Background Notes**



Carbon dioxide reacts with ocean water to produce bicarbonate and hydrogen ions

ISP203A Global Change  
Chemical Equilibrium & Ocean Acidification

GROUP #:  
Student IDs of Members Present:

**Class Notes**

Complete the tables below as we go over them in class.

Table A. See Saw and CO<sub>2</sub> in the Ocean/Atmosphere

See Saw	CO <sub>2</sub>	How related?
Weight 1	gas in water	
Weight 2	gas in atmosphere	
Fulcrum	Temp. of ocean water	

Table B. See Saw and Ocean Acidification

See Saw	Ocean Acidification	How related?
Increasing Weight 2	adding CO <sub>2</sub> in the atmosphere	changes the equilibrium
Impact of increasing Weight 2 on Weight 1	More CO <sub>2</sub> in air dissolves into ocean	
Fulcrum	temperature changes	system is in the equilibrium

**NOTES:**

ISP203A – Global Change  
Chemical Equilibrium & Ocean Acidification

**Part 2: Group Work**

In Table C, use the see saw analogy to illustrate how changes in CO<sub>2</sub> in the atmosphere causes changes to CO<sub>2</sub> in the ocean.

Table C. Changes in CO<sub>2</sub> and relation to see saw analogy

See Saw	CO <sub>2</sub>	How Related?
Increasing Weight 2	More CO <sub>2</sub> in the air	It changes the equilibrium
Impact of Increasing Weight 2 on Weight 1	More CO <sub>2</sub> in the air causes more CO <sub>2</sub> to be dissolved in the ocean.	Change on both side is needed for equilibrium to be reached.
Increasing Distance 2	Increase in temperature	The fulcrum is the extra variable like temperature that affects the equilibrium.
Decreasing Distance 2	Decrease in temperature	" ↓ ↓ "

In Table D, identify the differences between a see saw and ocean acidification

Table D. Differences Between a See Saw and Ocean Acidification

See Saw	Difference	Oceans
Gravitational	Type(s) of energy	Thermal
Movement	What causes changes in the system? Movement or change of matter or energy?	Change of matter or energy

Explain in words how changes in CO<sub>2</sub> in the atmosphere can cause changes in CO<sub>2</sub> in ocean water.

The more CO<sub>2</sub> there is in the atmosphere will cause more CO<sub>2</sub> to be dissolved into the ocean to reach equilibrium.

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**Questions:**

A. How does temperature of ocean water affect the acidity of the oceans?

As temperature increases acidity decreases.

B. Imagine the Sun begins to emit more light, resulting in a warming of Earth's atmosphere. How would ocean acidification be affected?

The water temperature would increase causing ocean acidification to decrease.

C. Explain why increasing carbon dioxide in the atmosphere may lead to increased ocean acidification.

Increasing  $\text{CO}_2$  in the atmosphere causes an imbalance, so to reach equilibrium the  $\text{CO}_2$  in the atmosphere would dissolve into the ocean, increasing ocean acidification.

D. Why do you think ocean acidification could be a problem for human society?

To little acidification would cause a decrease in calcium. To much acidification deform shells made.